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XVI.—*A Description of some Fossil Corals and Echinoderms from the South-Australian Tertiaries.* By P. MARTIN DUNCAN, M.B. (Lond.), F. & Sec. Geol. Soc.

[Plates V. & VI.]

THE interesting simple Corals about to be described came from Muddy Creek and the Murray beds, and the Echinoderms from the latter locality*. The forms are more interesting, as yet, zoologically than geologically; for very little can be determined from them concerning the age of the beds whence they were derived. The great Australian Tertiary formation is not of one age, but the fossils from Muddy Creek and the Murray give part of it a synchronism with the Upper Miocene and older Pliocene of Europe, and with the latest Miocene Coral-beds of the West Indies. Very probably the Tertiaries of Java, described by Mr. Jenkins †, and those whose Echinoderms have been studied by Herklots ‡, are of the same relative age.

List of Species.

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| 1. <i>Caryophyllia viola</i> , n. sp. | 8. <i>Trochoseris Woodsi</i> , n. sp. |
| 2. <i>Flabellum Victorie</i> , n. sp. | BRYOZOON. |
| 3. — <i>Gambierense</i> , n. sp. | 9. <i>Cellepora Gambierensis</i> , <i>Busk.</i> |
| 4. — <i>Candeanum</i> , <i>Edwards</i>
& <i>Haime.</i> | ECHINODERMATA. |
| 5. <i>Placotrochus elongatus</i> , n. sp. | 10. <i>Hemipatagus Forbesi</i> , <i>Woods</i>
& <i>Dunc.</i> |
| 6. — <i>deltoideus</i> , n. sp. | 11. <i>Clypeaster folium</i> , var.,
<i>Agassiz.</i> |
| 7. <i>Balanophyllia Australiensis</i> ,
n. sp. | |

* Most of the specimens were sent to me by the Rev. J. Woods, of Penola, the learned author of 'Geological Observations in South Australia;' several were already in the cabinet of the Geological Society.

† Quart. Journ. Geol. Soc. vol. xx. p. 45.

‡ Echinoderms (Leyden).

1. *Caryophyllia viola*, nobis, n. sp. Pl. V. fig. 1.*Turbinolia viola*, Woods, MS.*

The coral is cuneiform and very compressed at the base, which is rounded inferiorly. The calice is elliptical and shallow. The septa are delicate; the principal are exsert and rounded, having large lateral spiny granules. There are six systems of septa, and four cycles. The three first orders are nearly equal; but the septa of the fourth and fifth orders are small, curve towards and touch the tertiary. The pali are tall rounded lobes on the tertiary septa; they are stout, larger than the end of the septa, and are sparsely granular. The columella is long and papillary. The costæ are visible to the base, are slightly wavy in their course, are separated by distinct grooves, and are of different lengths, those of the higher orders joining the others which reach to the base. All are visibly crenulate and faintly granular.

In form the coral resembles a *Sphenotrochus*, the papillæ on the columella resemble those of *Brachycyathus*: the single row of pali and the distinct costæ determine it to be one of the *Caryophylliæ*; but the absence of an epitheca is remarkable. It is a very beautiful form, and, without its calice, would be taken for an Eocene Turbinolian.

Height $\frac{4}{10}$ inch; length of calice $\frac{3}{10}$ inch, width of calice $\frac{2}{10}$ inch.

Locality.—Violet Creek, near Muddy Creek, South Australia.

2. *Flabellum Victoriae*, n. sp. Pl. V. fig. 2.

The coral presents a large basilar erosion, the result of the breaking-off of the peduncle: it has a sharp lateral spine on either side, which projects outwards and downwards, and which is situate immediately above the erosion. The coral is tall, compressed more below than above; its sides are slightly concave, and it is furnished with an epitheca which has faint transverse markings. The sides of the coral, were they produced towards the attachment, would form an angle of about 20°; they are rounded off, and only present the spine already noticed. The calice is elliptical; the plane of the smaller axis is slightly higher than that of the larger; the fossa is shallow, but centrally deep, narrow, and long, and the wall is thin. The septa are delicate, not exsert, are very slightly rounded, marked by large granules in series, and are unequal. There are four cycles in six systems, the primary and secondary septa being equal. There is no columella. The costæ are not represented by the

* The specimen was thus labelled by the Rev. J. Woods. I have not seen the MS.

rounded longitudinal markings beneath the epitheca, but the septa are continuous with the furrows between. There are therefore no costæ, but the intercostal spaces are developed into rounded ridges.

Height $\frac{6}{10}$ inch; length of calice $\frac{4}{10}$ inch, breadth of calice $\frac{1}{10}$ inch.

Locality.—Muddy Creek, South Australia.

3. *Flabellum Gambierense*, n. sp. Pl. V. fig. 3.

The coral is tall, faintly curved, has a long tapering pedicel, concave sides, and neither crests nor spines; it is compressed, has a strong epitheca, whose folds are arched and finely linear, and a calice oval-elliptical in shape. The septa are in six systems of four cycles; the primary and secondary are equal, stout, granular, and enlarged internally, where their ends form a rudimentary parietal columella. The other septa are smaller and granular. The costæ are but slightly developed.

Height of coral $\frac{1}{10}$ inch; length of calice $\frac{1}{10}$ inch; width of calice $\frac{1}{10}$ inch.

Locality. Tertiaries of Mount Gambier, South Australia. Coll. Geol. Soc.

4. *Flabellum Candeanum*, Edwards & Haime.

This species, now existing in the Chinese seas, is found fossil in the Murray Tertiaries of South Australia. Coll. Geol. Soc.

5. *Placotrochus elongatus*, n. sp. Pl. V. fig. 4.

The coral is very tall in relation to its breadth, straight, greatly compressed, especially inferiorly, finely pedicellate and cuneiform. The sides are rounded, slightly swollen out here and there, and form an angle of about 15° – 20° . The anterior and posterior surfaces are flat. The calice is small, elliptical, and rounded at the sides; it has slightly exsert septa, which are rounded, thin, delicate, unequal, and in six systems of four cycles. The fossa is central, deep, and long; the columella is seen at the bottom of it as a distinct, straight lamella: the columella is stout in the body of the coral, and is thinner at its free edge; laterally it is marked by distinct papillæ, which mark the junction of the principal septa, and it is "essential." The lamellæ of the septa are delicate, highly granular, and are often wavy at the inner margin. The small axis of the calice is slightly higher than the longer. The costæ are faintly marked. The epitheca is in strong curved folds.

Height $\frac{8}{10}$ inch; length of calice $\frac{1}{10}$ inch, breadth of calice $\frac{1}{10}$ inch.

Locality. Muddy Creek, South Australia.

6. *Placotrochus deltoideus*, n. sp. Pl. V. fig. 5.

The coral is conical, finely pedicellate, greatly compressed inferiorly, less so superiorly, has a rugged, sharp, not very prominent costal projection on either side, but is not spined. The calice is large, elliptical, with rather acute ends; apparently, the smaller axis is higher than the longer; its wall is thin, and the fossa is shallow, except centrally, where it is deeper and presents the thin lamellar columella. The septa are numerous, unequal, the larger touching the columella and joining it by small processes, the smaller reaching but a little distance inwards. There are six systems and five incomplete cycles. The septa are not exsert, are feebly arched, and are very delicate; the laminæ are granular, and their internal margin is often wavy. The columella is very sharp, thin, faintly papillate, and distinct. The costæ are small, except the lateral crests. The epitheca is strongly developed, being in arched ridges. The costæ are often chevroned beneath it. The lateral crests form an angle of 60° .

Height of coral 1 inch; length of calice $\frac{2}{10}$ inch, breadth of calice $\frac{4}{10}$ inch.

Locality. Muddy Creek, South Australia.

Variety: *Bursarius*, with the lateral crests forming convex ridges inferiorly.

7. *Balanophyllia Australiensis*, n. sp. Pl. VI. fig. 1.

The corallum is pedicellate, free, long, cylindrical, tapering and occasionally curved. The calice is elliptical, the fossa is shallow, the septa are not exsert, and the columella is large. There are five cycles of septa in six systems, the smaller septa joining others very close to the wall of the calice, which is thin. The costæ are numerous, equal, and consist of fine laminæ, each of which has two rows of delicate dentations connected transversely. The epitheca is seen near the base.

Height of coral $1\frac{1}{2}$ inch; width of calice $\frac{1}{10}$ inch.

Locality. Muddy Creek, South Australia.

8. *Trochoseris Woodsi*, n. sp. Pl. VI. fig. 2.

The coral is fixed by a small pedicel, above which it expands at first irregularly, and then largely. The wall is covered by a pellicular epitheca, which shows traces of subequal costæ. The calice is widely open, irregularly circular, with a thin edge and a small central fossula. The septa are not exsert, are crowded and delicate, there being not much difference in the size of those of the principal cycles; in six systems of five cycles, with half a sixth in each. The smaller septa very generally join the larger, and the larger reach the central fossula. The laminæ

are delicate, straight, and well marked laterally by the synapticulæ. The columella is small.

Height $\frac{7}{10}$ inch; breadth of calice $\frac{6}{10}$ inch.

Locality. Muddy Creek, South Australia.

BRYOZOON.

9. *Cellepora Gambierensis*, Busk.

Locality. Muddy Creek, South Australia.

ECHINODERMATA.

10. *Hemipatagus Forbesi*, Woods & Duncan. Pl. VI. fig. 3.

Spatangus Forbesi, Woods.

Hemipatagus Hoffmanni, Goldf. sp. (Sturt).

This common Echinoderm has been confounded both with the *Hemipatagus Hoffmanni*, Goldf., of Bünde, and with the *Hemipatagus Grignonensis*, Agass., whose synonym, *Spatangus Omalii*, Galeotti, will be recognized as denoting a form described by E. Forbes in the Belgian Eocene. The Rev. J. Woods has called it *Spatangus Forbesi*; but I cannot find any description of it, although it is figured (p. 75, 'South Australia,' Woods). The species is clearly not *H. Hoffmanni*, and Sturt's mistake was corrected by Mr. Woods. Mr. Woods having figured the species, I append his name with my own.

Test depressed, rather cordiform, nearly as broad as long, rounded and sulcated in front, rather angular laterally and truncated posteriorly. It is highest posteriorly, where it is roof-shaped; and it slopes gradually anteriorly. The ambulacral summit is nearly central. Inferiorly the test is slightly concave and irregular; the plastron is smoother than the rest; the peristome is transverse, semilunar, and there is a prominent posterior lip. The anterior sulcus is broad, shallow, and rounded. The ambulacral areas are lanceolate, the anterior being wide apart. The poriferous zones are sunken and broad; the pores are conjugate; the interporiferous zones are slightly raised, and are faintly tuberculated. There are four generative pores, the anterior pair being closer than the posterior. There are no large tubercles in the posterior interambulacral space or in the posterior third of the central space; they are large and few in the rest of the interambulacral spaces. The very small tubercles of the posterior space are very crowded. The large tubercles which are seen inferiorly also are nearly cylindrical, perforate, but not crenulate; the scrobicula is deep, and the tubercles are often in contact with one part of the scrobicular circle.

Height of specimens $\frac{1}{2}$ inch, length 1 inch.

Locality. The Murray, Mount Gambier, South Australia.
Coll. Geol. Soc.

The species is closely allied to *H. Hoffmanni*, Goldf.; but it has non-crenulate tubercles, which have a tendency to touch the scrobicular circle. It is easily distinguished from the Javan Tertiary species, and from the *Hemipatagus Grignoniensis*.

11. *Clypeaster folium*, Agassiz.

Var. with a marginal periproct.

Locality. Muddy Creek, the Murray, South Australia. Coll. Geol. Soc.

Remarks on the Species.

The *Caryophyllia viola* is readily distinguished by the structure of its costæ, the rounded and compressed base, the papillary columella, and the tall pali. At first sight it resembles the *Pleurocyathi* of the German Oligocene, but a careful examination determines its genus readily. The new species has no resemblance to the *Caryophyllia* of the Sicilian Pliocene, and it has not any recent allies. The generic name of *Cyathina* appears to have met with little favour of late; and the species formerly classified under that name are now termed *Caryophylliæ* by M. Milne-Edwards, the old *Caryophylliæ* becoming *Lithophylliæ*.

The three species of the genus *Flabellum* are remarkable: one is known to exist at the present day on the Chinese coast, and the others are new to zoology. *F. Candeanum* and the new *F. Victoriae* are the first instances of fossil *Flabella truncata*. The species included in this section of the genus have as yet been found as recent Corals in the Chinese, Oceanic, and Australian waters. It was to be expected that some of them, or some extinct members of the section, would be found in the Tertiaries of Australia.

The *F. Gambierense* is a pedicellate species, with a low septal number; and its nearest species (remote, however) is *F. Gallapagense* (Miocene).

The *Placotrochi* are also remarkable; for either both the species indicate that the lamellar columella is an insufficient generic distinction, or they afford an extraordinary example of mimetism in two closely allied genera. The genus *Flabellum* does not differ from the genus *Placotrochus*, except that it has no essential and lamellar columella; but there are parallel species of both genera with the columellar distinction alone. That is to say, there are pedicellate *Flabella* and *Placotrochi*—some compressed, with lateral crests, numerous septa, and wide calices, others without crests, and some are cuneiform: there are truncate species of both genera, and in Jamaica (Miocene of Bowden) there is a section in which both genera are costulated and

without epitheca. The species *P. alveolus* (nobis), from the West-Indian Miocene, is unique.

The first species of the genus were described by MM. Milne-Edwards and Jules Haime*—the *P. lævis* of the Philippines and *P. Candeanus* of the Chinese seas. The next species were described in my Essay on the Fossil Corals of the West-Indian Islands†. The *P. Lonsdalei* resembles the *Flabellum avicula* in many respects; but the *P. alveolus* is unlike any other species in its general shape. Lately some fossils from the Jamaica Miocene have been described by me; but they are not yet published: amongst them are *P. costatus* and the *Flabellum* which is mimetic—the *Flabellum exaratum*, Dunc. MSS. The group then stands as follows, with its mimetic *Flabella*:—

<i>Pedicellate Placotrochi.</i>	<i>Pedicellate Flabella.</i>
Placotrochus Lonsdalei, Dunc.	Flabellum avicula, Mich., sp.
— deltoideus, n. sp.	— Siciliense, E. & H.
— elongatus, n. sp.	— cuneiforme, Lonsdale.
<i>Truncate Placotrochi.</i>	<i>Truncate Flabella.</i>
Placotrochus Candeanus, E. & H.	Flabellum compressum, Lamk., sp.
— lævis, E. & H.	— crenulatum, E. & H.
<i>Placotrochus without epitheca.</i>	<i>Flabellum without epitheca.</i>
Placotrochus costatus, n. sp.	Flabellum exaratum, n. sp.
<i>Anomalous.</i>	
Placotrochus alveolus, Dunc.	

The truncate *Flabella* are all recent, except in the instance now noticed; and, until the discovery of *Placotrochus Candeanus* in the Muddy Creek, the truncate *Placotrochi* were the recent forms: all the others belong to the Miocene age. There is no more than a generic relation between the West-Indian and the Australian Tertiary *Placotrochi*.

The new *Balanophyllia* has only a generic affinity with *B. Cumingii*, E. & H., of the Philippines, and is more closely allied to the *B. pralonga*, Michel., sp., of the Turin Miocene: it belongs to the same section of the genus as the Italian form, and they have several peculiarities in common. The new species is nothing like our Crag species.

The *Trochoseris Woodsi* has only a generic affinity with the *T. Stokesi*, E. & H., from the Philippines, and is very distinct from the Eocene forms.

Cellepora Gambierensis, Busk, is a characteristic fossil of the Mount-Gambier Tertiaries.

* Hist. Nat. des Corall. vol. ii. p. 98.

† Quart. Journ. Geol. Soc. vol. xix.

Hemipatagus Forbesi appears to be a common fossil in the South-Australian Tertiaries. The genus is separated from *Spatangus* by Desor*, on account of the defective fascioles and of the absence of large tubercles in the posterior interambulacral area. The European species are found in Eocene and Miocene strata, and *H. Hoffmanni*, the nearest alliance of the new form, is from Malta and Bünde. The species from the Java Tertiaries are not closely allied to the Australian †.

The flat *Clypeaster*, which is also a common fossil, so closely resembles *C. folium* of the Maltese bed (No. 2) as to merit the title of a variety; and this opinion is not weakened by the existence of a *Schizaster* in the Adelaide Tertiaries, which (although defective specimens alone are in my possession) is not distinguishable from *S. Parkinsoni*, DeFrance, of Malta.

EXPLANATION OF THE PLATES.

PLATE V.

- Fig. 1. *Caryophyllia viola*: *a*, front view, natural size; *b*, magnified 4 diameters; *c*, costæ magnified 6 diam.; *d*, septa, pali, and papillary columella, magnified 4 diam.
- Fig. 2. *Flabellum Victoriae*: *a*, front view, natural size; *b*, calice, magnified 2 diam.; *c*, erosion, magnified 2 diam.; *d*, costal arrangement, magnified 4 diam.
- Fig. 3. *Flabellum Gambierense*: *a*, front view; *b*, calice, magnified 2 diam.; *c*, epitheca, and *d*, enlarged ends of septa, magnified 4 diam.
- Fig. 4. *Placotrochus elongatus*: *a*, front view, natural size; *b*, the same of another specimen; *c*, side view, part of coral removed to show the columella; *d*, calice, and *e*, columella, magnified 4 diam.
- Fig. 5. *Placotrochus deltoideus*: *a*, front view; *b*, columella, magnified 4 diam.; *c*, variety *Bursarius*, front view.

PLATE VI.

- Fig. 1. *Balanophyllia Australiensis*: *a*, front view, natural size; *b*, part of a coral, natural size; *c*, septa, magnified 4 diam.; *d*, costæ, magnified 4 diam.
- Fig. 2. *Trochoseris Woodsi*: *a*, corallum, natural size; *b*, septa in calice, magnified 2 diam.; *c*, septa, magnified to show synapticulæ.
- Fig. 3. *Hemipatagus Forbesi*: *a*, upper view; *b*, side view; *c*, posterior view; *d*, under side (all natural size); *e*, apical summit, generative pores, *f*, pores and ambulacral tubercles, *g*, large tubercles, magnified 4 diam.

* Synopsis des Echinides, p. 416.

† Since the completion of this paper, I have received Karl A. Littel's 'Fossile Mollusken und Echinodermen aus Neu-Seeland.' The *Hemipatagus tuberculatus* therein described, and decided to be specifically distinct from *H. Forbesi*, is very closely allied.